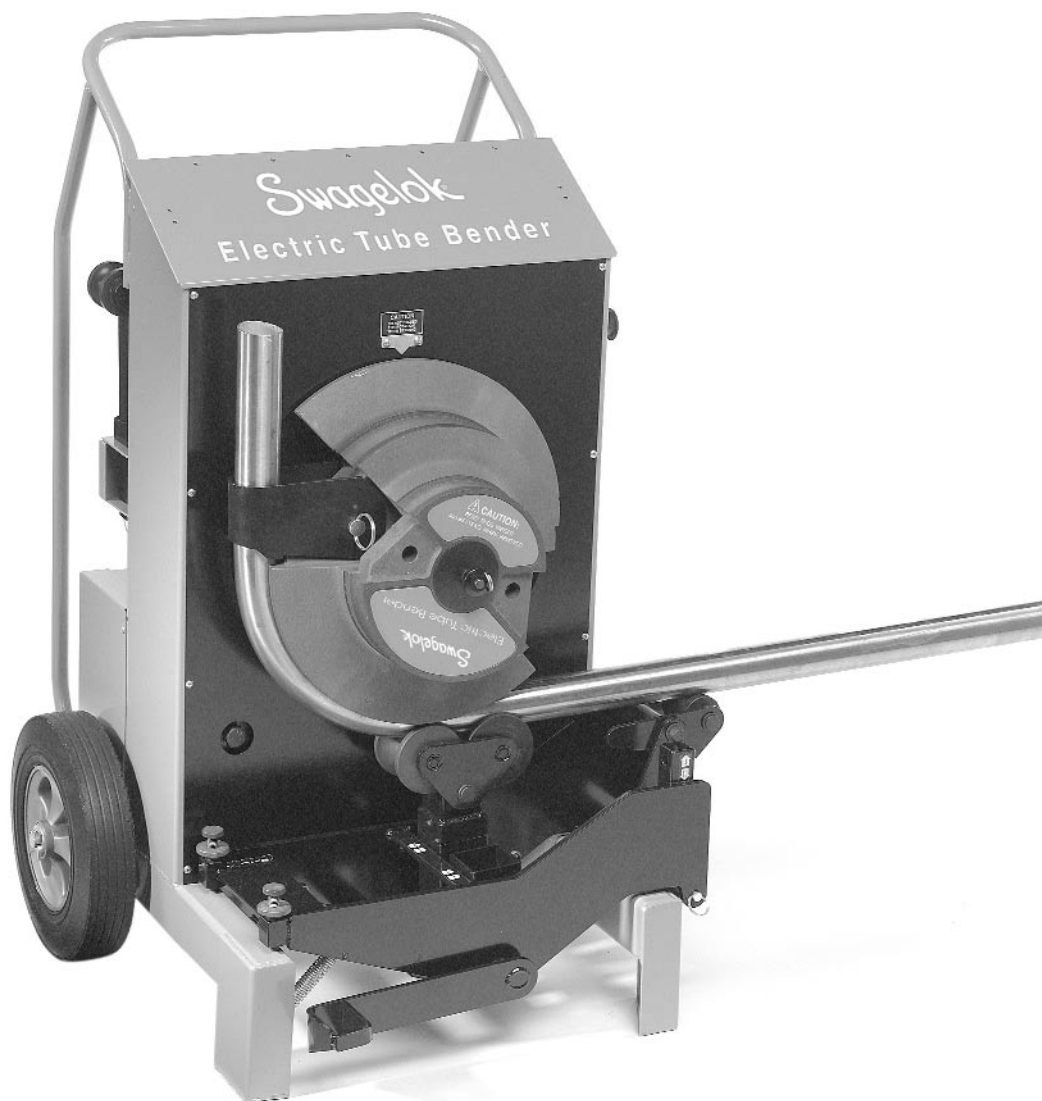


Electric Tube Bender

User's Manual



Swagelok®

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SAVE THESE INSTRUCTIONS!

Operator's Safety Summary

READ AND UNDERSTAND THIS MANUAL BEFORE USING BENDER. This device is electrically powered and must be operated in a safe environment to avoid risk of fire, explosion, or electric shock.

Grounding and Extension Cord Information

- Bender **MUST** be grounded to guard against electrical shock. It is equipped with a three-wire conductor and three-prong plug to fit a grounded receptacle.



NEVER CONNECT THE GREEN OR GREEN/YELLOW WIRE TO A LIVE TERMINAL!

- Use only three-wire extension cords that have three-prong grounding-type plugs and three-pole receptacles.
- The extension cord wire size must meet the following specifications:
 - For 0 to 50 ft (0 to 15 m), the recommended minimum wire gauge is #12 AWG (2.5 mm).
 - For 50 to 100 ft (15 to 30 m), the recommended minimum wire gauge is #10 AWG (4.0 mm).

Statements

CAUTION! Statements that identify conditions or practices that could result in damage to the equipment or other property

WARNING! Statements that identify conditions or practices that could result in personal injuries or loss of life

Symbols



CAUTION!

Indicates cautionary information.



WARNING!

Indicates that voltage greater than 30V (ac) is present.



WARNING!

PINCH POINTS. Keep hands, loose clothing, and long hair away from moving parts. Serious injury can occur.



WARNING!

KEEP DRY. Do not expose the equipment to water or wet locations.



WARNING!

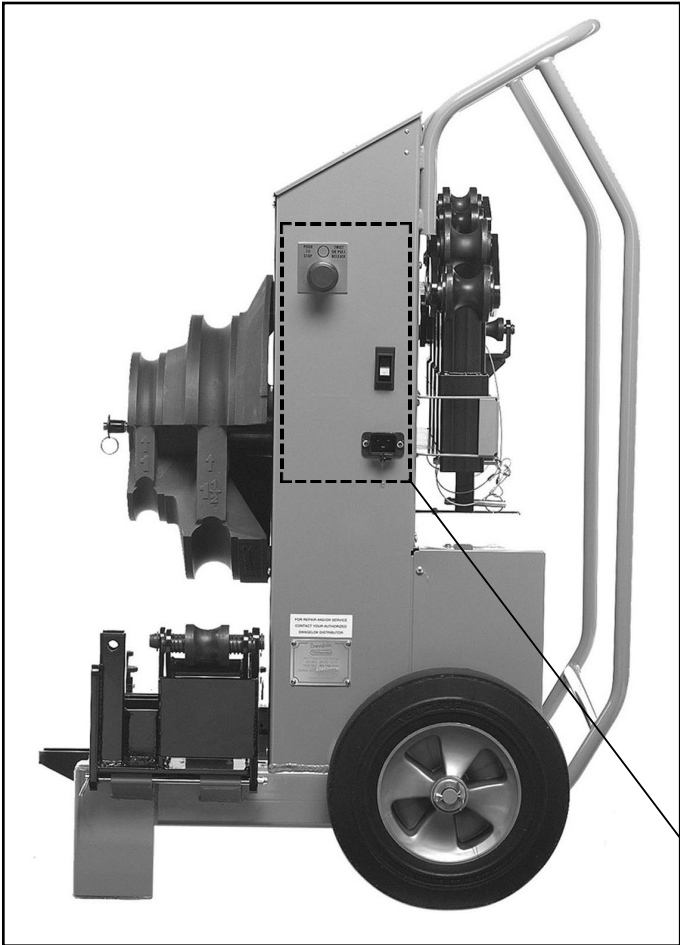
FIRE OR EXPLOSION. Do not use equipment in a combustible or explosive atmosphere. Flammable liquids or gases could ignite.



WARNING!

EYE PROTECTION. Eye protection must be worn while operating or working near the equipment.

Safety Features



Emergency Stop Button

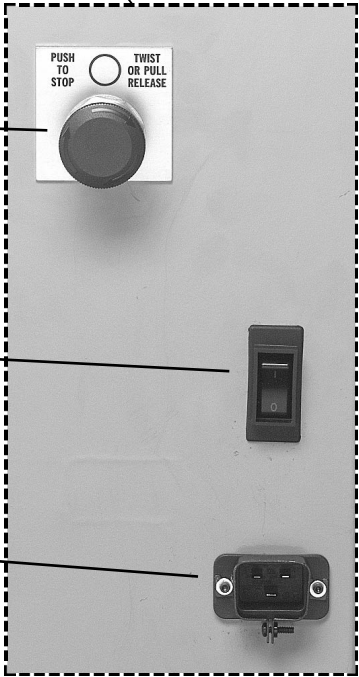
Stops rotation of bend shoe and clears all settings. Auto bend function will require reprogramming.

Circuit Breaker

Disconnects power from outside source. Clears all settings.

Receptacle with Cord/Socket Lock

Plug in power cord. Tighten screw on cord/socket lock to secure power cord.



Tube Bender Technical Data

BENDING RANGE:	1° to 110°, in 1° increments. Bending in excess of 110° may damage bender.	
DIMENSIONS:	Vertical Position: 44 in. (112 cm) high, 29 in. (74 cm) wide, 30 in. (76 cm) deep	
WEIGHT:	420 lb (191 kg)	
POWER REQUIREMENTS:	MS-TBE-1	MS-TBE-2
	115 V (ac) 50/60 Hz	230 V (ac) 50/60 Hz
	Maximum current: 13 A	Maximum current: 7 A

Tubing Information

- All tubing should be free of scratches and suitable for bending.
- Bends 1, 1 1/4, 1 1/2, and 2 in.; 25, 32, 38, and 50 mm OD tubing in a variety of wall thicknesses.
- Carbon steel tubing should be soft (annealed), seamless (ASTM A179), or welded and drawn, DIN 2391-1 and DIN 2391-2 or equivalent, with a hardness of 72 HRB, HV (VPN) 130 or less.
- Stainless steel tubing should be fully annealed, seamless, or welded and drawn, meeting ASTM A269, ASTM A213, EN ISO 1127, or equivalent specification, with a hardness of 90 HRB, HV (VPN) 180 or less.
- The following information for bending annealed tubing is listed below in Table 1: bend radius, wall thickness limits, and minimum straight length required to make a 90° bend using the tail roller.

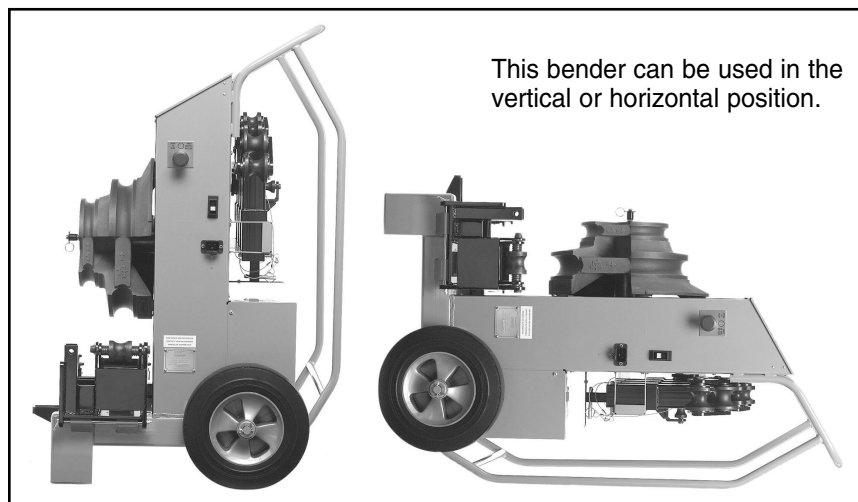
Table 1 – Min/Max Wall Thickness^①

Tube OD in.	Dimensions, in.			
	Min Length	Bend Radius	Carbon Steel	Stainless Steel
1	20 1/2	4	0.049/0.120	0.065/0.120
1 1/4	22 3/4	5	0.065/0.180	0.083/0.156
1 1/2	25 1/2	6	0.083/0.220	0.095/0.188
2	32	8	0.095/0.220	0.109/0.188

Tube OD mm	Dimensions, mm			
	Min Length	Bend Radius	Carbon Steel	Stainless Steel
25	520	103	1.2/3.0	1.8/3.0
32	582	126	2.0/4.0	2.0/4.0
38	648	152	2.2/4.5	2.2/4.5
50	810	203	—	3.0/5.0

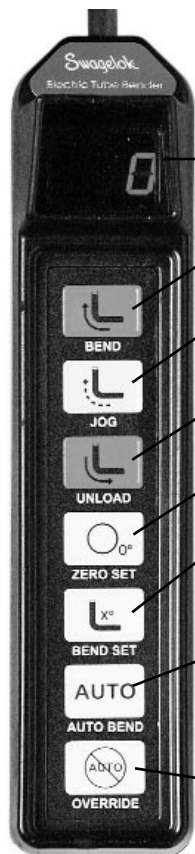
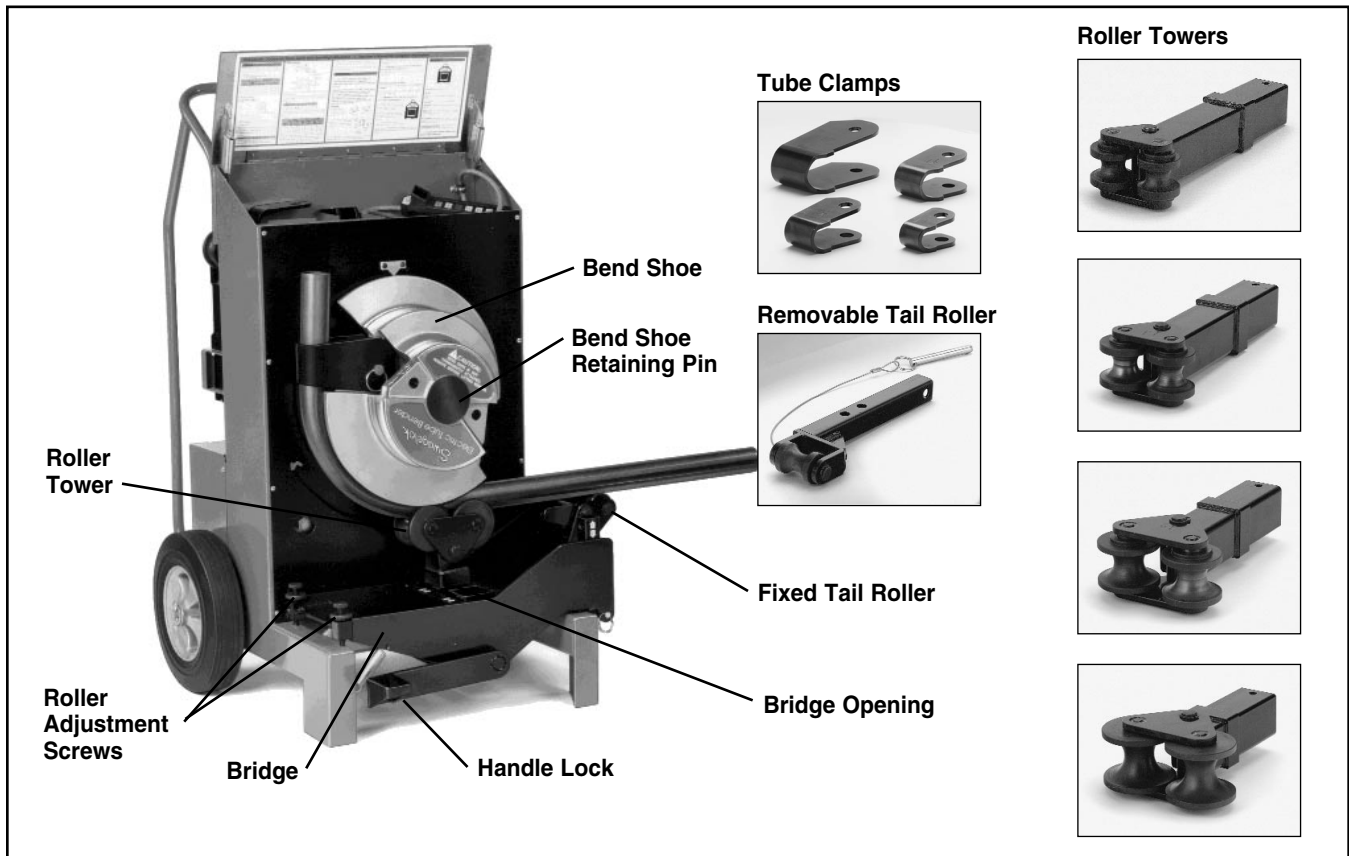
^① See the *Swagelok Tubing Data* catalog for suggested tubing wall thickness for use with Swagelok tube fittings.

***READ AND BECOME FAMILIAR WITH OPERATING INSTRUCTIONS
BEFORE BENDING TUBING!***



Before using bender make sure rollers and shoe grooves are in line. See Roller Alignment (page 13).

Tube Bender Components



Digital Display Pendant

LED DISPLAY – Displays degrees of rotation.

BEND – Rotates bend shoe clockwise.

JOG – Rotates bend shoe clockwise in 1° increments.

UNLOAD – Rotates bend shoe counterclockwise.

ZERO SET – Resets pendant display to "0."

BEND SET – Stores a bend in memory. Indicator light on display (center decimal point) will flash to confirm bend is stored.

AUTO BEND – Rotates bend shoe to the angle stored in memory. Auto bend indicator light (right decimal point) remains on when bending with memory.

OVERRIDE – Overrides the AUTO BEND mode without erasing memory.

Error Message

An "E1" in pendant display indicates that the motor has stopped. Remove any obstruction in bend shoe, and retry the BEND or UNLOAD function.



CAUTION!

Pressing color key pad functions on the pendant causes bend shoe to rotate.

Assembling Components

1. Select and install proper tail rollers. To bend 1 1/2 in. (38 mm) OD tubing, use the fixed tail roller in the up position. For 2 in. (50 mm) OD tubing, use the fixed tail roller in the down position. (See Figure 1.)

To bend 1 in. (25 mm) OD tubing, use the 1 in. (25 mm) removable tail roller, securing pin in lower pin hole (up position). For 1 1/4 in. (32 mm) OD tubing, use the 1 1/4 in. (32 mm) removable tail roller, securing pin in upper pin hole. Align roller with the inside of the unit. (See Figure 2.)

2. Select proper roller tower; the size is indicated on roller tower. To install, lift and hold the handle lock. Insert the roller tower into proper bridge opening so that the size indicator faces you. Allow roller tower to lean against tail roller. (See Figure 3.)
3. Select proper tube clamp; the size is indicated on clamp face. Locate the tube size on the bend shoe, and attach the tube clamp with pin, making sure the size identification faces out. (See Figure 4.)
4. Make sure the circuit breaker is switched to the ON position and the EMERGENCY STOP button is not engaged.
5. Plug the unit into an appropriate power source. The display on the pendant will illuminate.

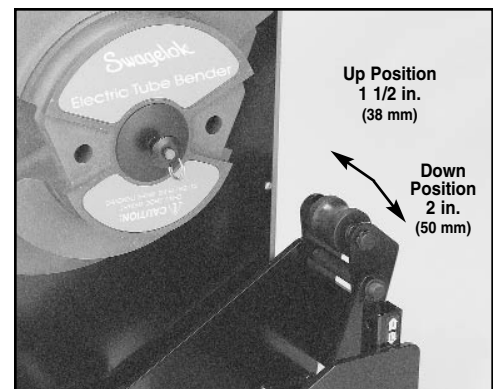


Figure 1

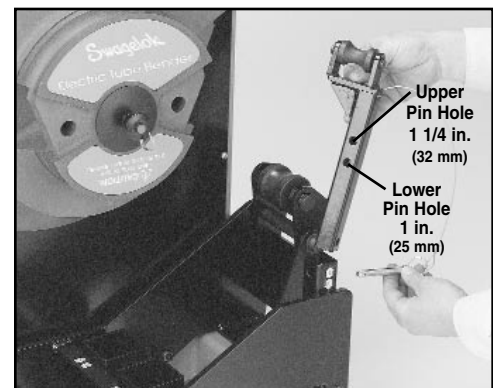


Figure 2

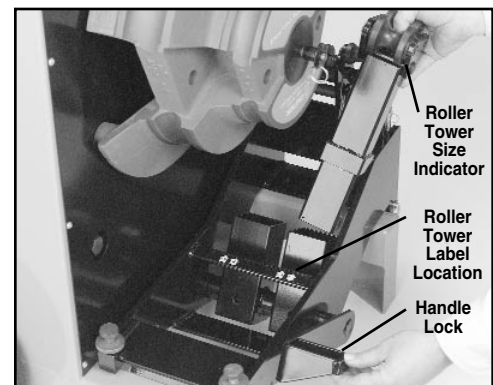


Figure 3

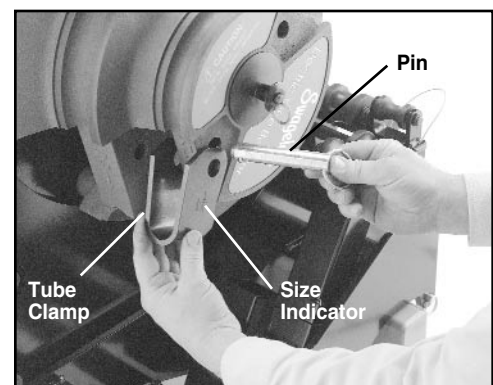


Figure 4

Tubing Layout

With this bender, you can form single, offset, and other bends. This section contains information for measuring and marking the tubing prior to bending. **NOTE: Make all marks 360° around the tubing.**

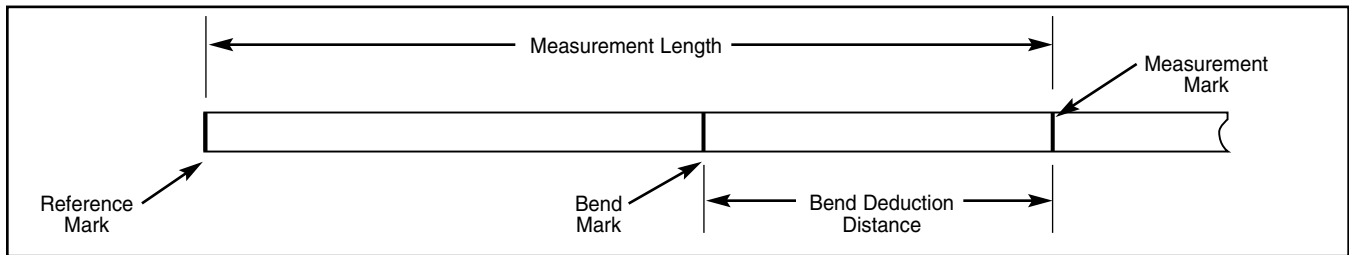


Illustration 1 – Single Bend 90°

Single 90° Bend

1. Place a reference mark at the end of the tubing from which your measurement begins.
2. From the reference mark at the end of the tubing, measure the desired length for the bend. Make a measurement mark on the tubing.
3. Subtract the bend deduction distance (see Table 2 on page 9) from the measurement mark and make a bend mark. (The bend deduction distance is a length that compensates for the bender and tube clamp design.)
4. To bend tubing, see Bending on page 11.

Multiple 90° Bends

The Measure-Bend Method

1. Follow Steps 1 to 4 above for a Single 90° Bend.
2. Using the center line of the previous 90° bend as your second reference mark, repeat Steps 2 to 4 for the second 90° bend.

EXAMPLE: Using 1 1/2 in. OD tubing, make two 90° bends with measured length distances of 18 in. between bend marks. (See Illustrations 2 and 3.)

1. From the reference mark at the end of the tubing, measure **18 in.** and make a measurement mark.
2. The bend deduction distance for 1 1/2 in. OD tubing in Table 2 is **9 7/8 in.**
3. $18 \text{ in.} - 9 \frac{7}{8} \text{ in.} = 8 \frac{1}{8} \text{ in.}$ Make the first bend mark at **8 1/8 in.**
4. Bend tubing.
5. From the center line of the first 90° bend, measure **18 in.** and make a measurement mark.
6. The bend deduction distance for 1 1/2 in. OD tubing in Table 2 is **9 7/8 in.**
7. $18 \text{ in.} - 9 \frac{7}{8} \text{ in.} = 8 \frac{1}{8} \text{ in.}$ Make the second bend mark at **8 1/8 in.** from the center line of the first 90° bend.
8. Bend tubing.

Note: Follow the above steps when using metric measurements.

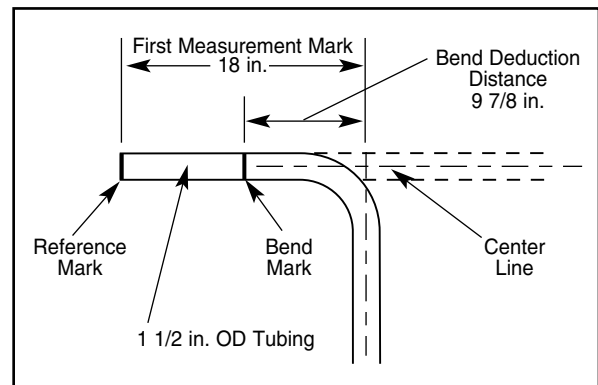


Illustration 2 – First 90° Bend

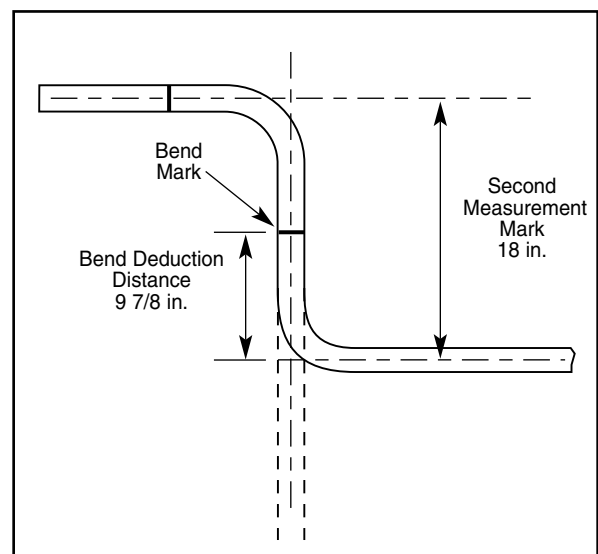


Illustration 3 – Second 90° Bend

Multiple 90° Bends

The Premeasure Method

1. Follow Steps 1 to 3 for a Single 90° Bend. (See page 8.)
2. From the reference mark at the end of the tubing, measure the desired length for the second bend and make a measurement mark.
3. Subtract the bend deduction distance (see Table 2) and the adjustment factor (see Table 3) from the second measurement mark, and make the second bend mark.

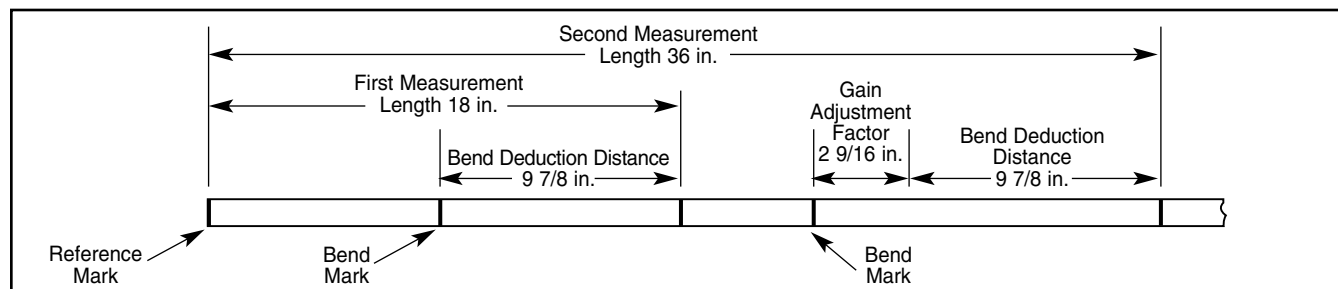


Illustration 4 – Multiple 90° Bends

EXAMPLE: Using 1 1/2 in. OD tubing, make two 90° bends with a measured length distance of 18 in. between bend marks. (See Illustration 4.)

1. From the reference mark at the end of the tubing, measure **18 in.** and make a measurement mark.
2. The bend deduction distance for 1 1/2 in. OD tubing in Table 2 is **9 7/8 in.**
3. $18 \text{ in.} - 9 \frac{7}{8} \text{ in.} = 8 \frac{1}{8} \text{ in.}$ Make the first bend mark at **8 1/8 in.**
4. Add the first and second measurement lengths.
 $18 \text{ in.} + 18 \text{ in.} = \mathbf{36 \text{ in.}}$
5. From the reference mark at the end of the tubing, measure **36 in.** and make a second measurement mark.
6. The bend deduction distance for 1 1/2 in. OD tubing is **9 7/8 in.**, and the adjustment factor for a 90° bend in Table 3 is **2 9/16 in.**

Table 2 – Bend Deduction Distance

Tube OD in.	Bend Deduction in.
1	6 1/2
1 1/4	8 3/16
1 1/2	9 7/8
2	12 5/8

Tube OD mm	Bend Deduction mm
25	177
32	213
38	247
50	318

7. $36 \text{ in.} - 9 \frac{7}{8} \text{ in.} - 2 \frac{9}{16} \text{ in.} = \mathbf{23 \frac{9}{16} \text{ in.}}$
8. From the reference mark at the end of the tubing, measure **23 9/16 in.** and make a second bend mark.
9. Bend tubing.

Note: Follow the above steps when using metric measurements.

Table 3 – Gain Factors for 0 to 90° Bends

	0°	1°	2°	3°	4°	5°	6°	7°	8°	9°
0°	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001	0.0001	0.0003	0.0003
10°	0.0005	0.0006	0.0008	0.0010	0.0013	0.0015	0.0018	0.0022	0.0026	0.0031
20°	0.0036	0.0042	0.0048	0.0055	0.0062	0.0071	0.0079	0.0090	0.0100	0.0111
30°	0.0126	0.0136	0.0150	0.0165	0.0181	0.0197	0.0215	0.0234	0.0254	0.0276
40°	0.0298	0.0322	0.0347	0.0373	0.0400	0.0430	0.0461	0.0493	0.0527	0.0562
50°	0.0600	0.0637	0.0679	0.0721	0.0766	0.0812	0.0860	0.0911	0.0963	0.1018
60°	0.1075	0.1134	0.1196	0.1260	0.1327	0.1397	0.1469	0.1544	0.1622	0.1703
70°	0.1787	0.1874	0.1964	0.2058	0.2156	0.2257	0.2361	0.2470	0.2582	0.2699
80°	0.2819	0.2944	0.3074	0.3208	0.3347	0.3491	0.3640	0.3795	0.3955	0.4121
90°	0.4292	—	—	—	—	—	—	—	—	—

Example: The gain factor for a 90° bend is 0.4292.

To calculate the gain for 90° bend multiply the gain factor times the bend radius.

Example: $0.4292 \times 6 \text{ in.} = 2.58$, or about $2 \frac{9}{16} \text{ in.}$ gain

Making Offset Bends

NOTE: Make all marks 360° around the tubing.

1. Make a reference mark at the end of the tubing from which your measurement begins.
2. From the reference mark at the end of the tubing, measure the desired length for the bend. Make a measurement mark on the tubing.
3. Subtract the clamp distance (see Table 4) from the first measurement mark and make a bend mark.
4. Determine the length of tubing (L) consumed in the offset. See Table 5 or use one of the offset bend allowances referred to in Table 6. (See Illustration 5.)
5. From the first bend mark, measure the distance required for the offset bend allowance and make a second bend mark.
6. Check for proper bend direction and tube orientation. To bend tubing, see Bending on page 11.

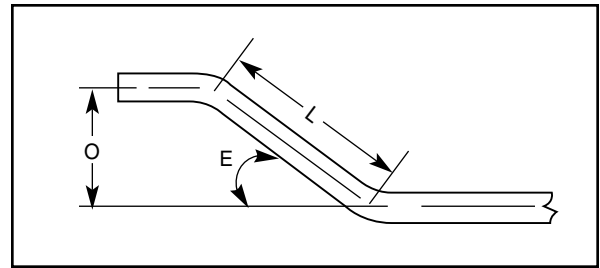


Illustration 5 – Tubing Length Offset

Table 4 – Clamp Distance

Tube OD in.	Clamp Distance in.	Tube OD mm	Clamp Distance mm
1	2 1/4	25	57
1 1/4	2 3/4	32	70
1 1/2	3 1/2	38	89
2	4	50	102

(Clamp distance only applies to offset bends.)

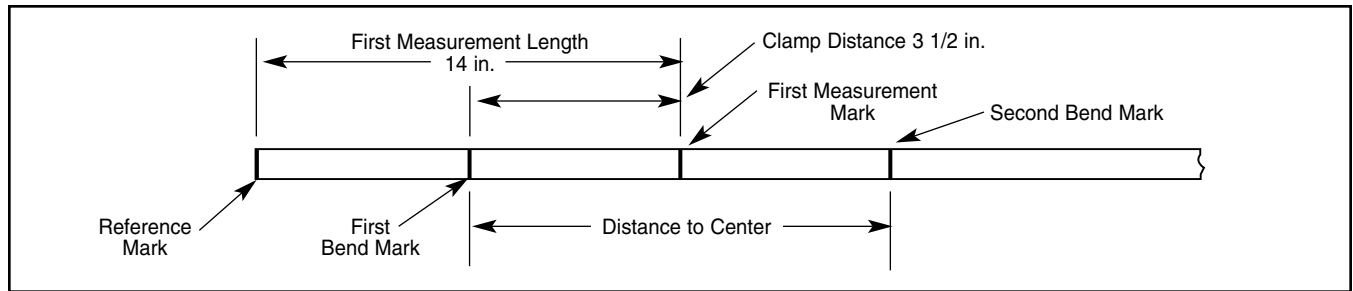


Illustration 6 – Offset Bends

EXAMPLE: Using 1 1/2 in. OD tubing, make an offset bend beginning 14 in. from the end of the tube with a 20 in. offset dimension (O) and a 30° offset angle (E). (See Illustration 6.)

1. From the reference mark at the end of the tubing, measure **14 in.** and make a measurement mark.
2. The clamp distance for 1 1/2 in. OD tubing in Table 4 is **3 1/2 in.**
3. 14 in. – 3 1/2 in. = 10 1/2 in. Make the first bend mark at **10 1/2 in.**
4. The 20 in. offset bend is not in Table 5. Calculate the center-to-center distance by multiplying 20 in. by the factor in Table 6 for a 30° offset, **2.000**. 20 in. × 2.000 = **40 in.**
5. From the first bend mark, measure 40 in. and make the second bend mark.
6. Bend tubing.

Note: Follow the above steps when using metric measurements.

Table 6 – Offset Bend Allowance

E Angle	L Length
30°	2.000 × O (offset)
45°	1.414 × O (offset)
60°	1.154 × O (offset)

Table 5 – Offset Bend Calculations

O Offset Dimension in.	30° Offset		45° Offset		60° Offset	
	Max Tube OD in.	L Center to Center in.	Max Tube OD in.	L Center to Center in.	Max Tube OD in.	L Center to Center in.
6	2	12	1 1/2	8 3/8	1	7
8		16	2	11 1/4	1 1/2	9 1/4
10		20		14	2	11 1/2
12		24		16 3/4		13 3/4
14		28		19 5/8		16 1/8
16		32		22 3/8		18 3/8
18		36		25 1/4		20 3/4

O Offset Dimension mm	30° Offset		45° Offset		60° Offset	
	Max Tube OD mm	L Center to Center mm	Max Tube OD mm	L Center to Center mm	Max Tube OD mm	L Center to Center mm
150	50	300	38	212	25	173
200		400	50	283	38	231
250		500		353	50	288
300		600		424		346
350		700		495		404
400		800		566		462
450		900		636		519

Springback

Bending the tubing approximately 3° beyond the desired angle is necessary to compensate for tubing springback.

NOTE: This is an approximate value. Tubing springback characteristics differ due to size, wall thickness, and material.



WARNING!
MOVING PARTS.

Bending

1. Press the BEND or UNLOAD function key. Rotate the bend shoe until the proper reference notch on the bend shoe is aligned with the pointer on the faceplate. (See Figures 5 and 6.) Note the difference in appearance of the bend shoe in each figure. The tube clamp should hang vertically from the bend shoe.

NOTE: If the bend shoe stops at 110° or -99°, reset the pendant display by pressing the ZERO SET function key. Then, press the BEND or UNLOAD function key to rotate bend shoe.

2. Insert tubing through tube clamp with reference mark toward the left (see Tubing Layout, page 8), making sure tubing is positioned over tower and tail rollers. Press the JOG function key until tubing rests on tail roller and fits tightly. Press the ZERO SET function key. This process ensures the bender is set correctly for bending.
3. Press the UNLOAD function key until the tubing can be moved by hand. (Display will read approximately -2.)
4. Slide tubing to align the bend mark with the left edge of the tube clamp. (See Figure 7.)
5. Lock the roller tower by pushing the handle lock down until the roller tower stops firmly against bridge. (See Figure 8.)
6. To bend, press and hold the BEND or JOG function key until the desired angle is displayed. The JOG function key will bend in 1° increments. Release the key to stop the bend shoe. Add approximately 3° to allow for springback.

CAUTION! Bending in excess of 110° may damage tubing and bender.

7. To remove tubing, stand clear of the handle lock, and press and hold the UNLOAD function key (approximately 5°) until roller tower unlocks by lifting slightly. Lift the handle lock and allow roller tower to lean against tail roller. Remove tube clamp and tubing. Inspect the tubing bend; if wrinkling, ovality, or sidemarking has occurred, see Troubleshooting on page 12.

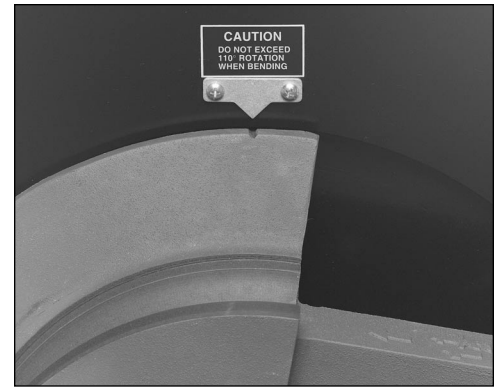


Figure 5 1 1/4 and 2 in. (32 and 50 mm)
Reference Notch



Figure 6 1 and 1 1/2 in. (25 and 38 mm)
Reference Notch

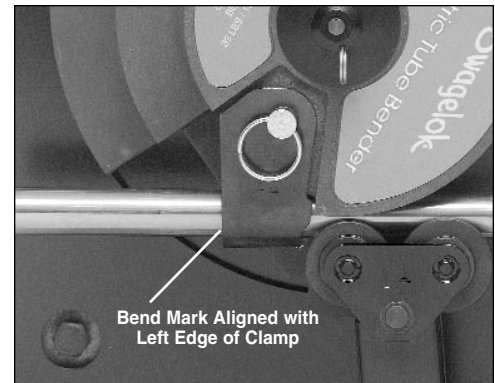


Figure 7

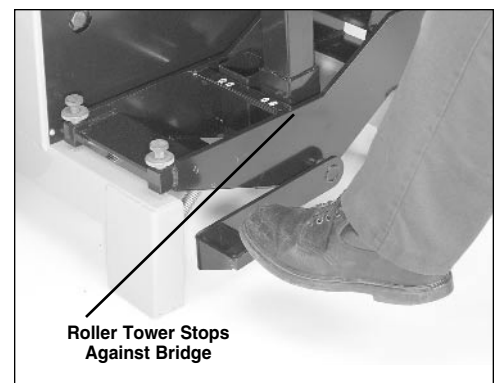


Figure 8

Bending Using Auto Bend

Use the auto bend feature to program a bend angle into the bender's memory for applications where a single bend angle must be repeated.

NOTE: A bend setting will be stored in memory until power is disconnected or a new bend is set.

1. Follow steps 1–3 under Bending (see page 11), then slide tubing completely away from tube clamp and bend shoe.
2. Press the BEND or JOG function key until the desired angle is displayed. Add approximately 3° to allow for springback. Press the BEND SET function key to store the bend angle. The BEND SET light (center decimal point) on the display pendant will flash momentarily. Press the UNLOAD function key until the display reads approximately –2.
3. Slide tubing through tube clamp and align the bend mark with the left edge of the tube clamp. (See Figure 9.)
4. Lock the roller tower by pushing the handle lock down until the roller tower stops firmly against bridge. Press the AUTO BEND function key. The AUTO BEND indicator light (right decimal point) will illuminate.
5. Press and hold the BEND function key. The bend shoe will rotate until the set angle is reached.
6. Follow step 7 under Bending.

NOTE: The auto bend function may be temporarily disabled to allow for bending of different angles, while maintaining the pre-set bend angle in memory. To disengage the auto bend function, either:

1. Press the AUTO BEND function key. The AUTO BEND indicator light will turn off, and the auto bend is disengaged. To reactivate the auto bend function, press the AUTO BEND function key. The indicator light will illuminate.
2. Press the OVERRIDE AUTO BEND function key to temporarily override auto bend function. The AUTO BEND indicator light will flash and the auto bend function is temporarily disengaged. To reactivate the auto bend function, press the OVERRIDE AUTO BEND function key. The indicator light will stop flashing.

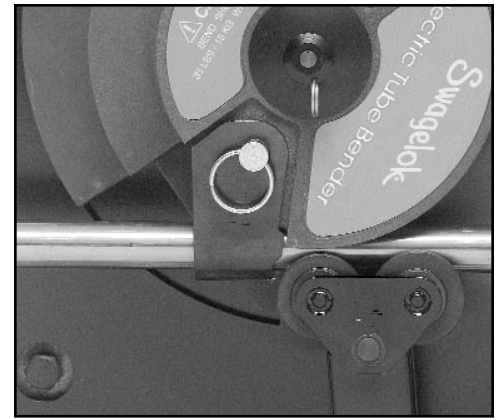
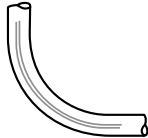
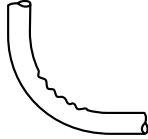
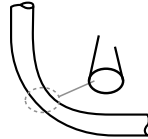


Figure 9

Troubleshooting

Bender adjustments can be made if any of the following conditions are encountered. See page 13 for specific instructions.

	Condition	Potential Cause	Solution
	Sidemarking	Rollers not aligned with bend shoe	Align rollers by turning roller alignment screws.
		Oversize tubing	Turn roller adjustment screws counterclockwise in quarter-turn increments until condition clears.
		Excess roller pressure	
	Wrinkling	Undersize tubing	Turn roller adjustment screws clockwise in quarter-turn increments until condition clears.
		Insufficient roller pressure	
	Ovality	Undersize tubing	Turn roller adjustment screws clockwise in quarter-turn increments until condition clears.
		Insufficient roller pressure	

Roller Adjustment Screws

The two roller adjustment screws on the left side of the bender (see Figure 10) change the pressure applied to the tubing. The factory setting (as viewed from the front) for these screws is the gap measured between the top of the bender frame leg and the bottom of the screw blocks.

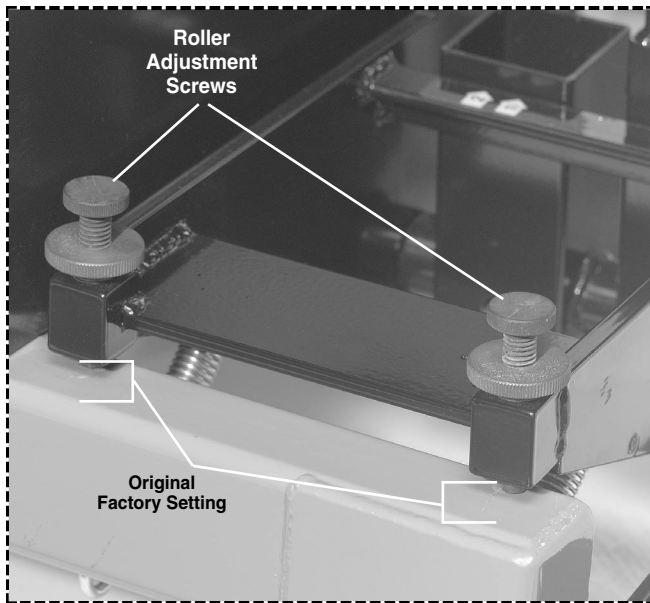


Figure 10



Notes:

- When the roller adjustment is changed to compensate for under or oversized tubing, return the roller screws to their original factory setting before bending a new length or lot of tubing.
- ZERO SET may need to be re-established. (See Bending, page 11, step 2.)
- Set the roller adjustment screws evenly to keep the bridge assembly level.

Roller Alignment

The two roller alignment screws, located on the rear side plate of the bridge assembly (see Figure 11), allow adjustment of the bridge assembly to keep the roller towers and bend shoe aligned. Misalignment can lead to sidemarking.

To Check Alignment:

- Viewing the bender from the side, look between the roller towers and the bend shoe. If the roller tower appears to be misaligned with the bend shoe, loosen the lock nuts on the roller alignment screws with a 9/16 in. wrench.
- Using a 3/16 in. hex key, turn the roller alignment screws until the roller tower aligns with the bend shoe. Tighten the lock nuts.
- Always set the roller alignment screws evenly to keep the bridge assembly parallel with the bend shoe.

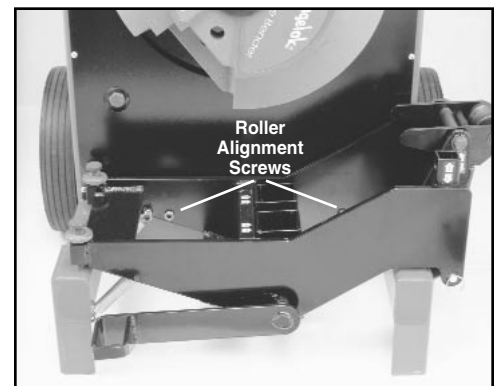


Figure 11

Maintenance

If this bender is subjected to flooding, severe impact, fire, or other extreme conditions, it should be inspected thoroughly by a trained technician before use.

Front Chain

The front chain requires no routine adjustment. However, it will stretch slightly after making the first 10 to 20 bends of 1 1/2 or 2 in.; or 38 or 50 mm OD heavy wall tubing. If there is any slack in the chain:

1. Disconnect the bender from the power source and remove the roller tower.
2. Remove the bend shoe retaining pin. (See Figure 12.)
3. Rock the bend shoe gently and pull forward until it clears drive lugs. Remove the bend shoe.



CAUTION!

Bend shoe weight is 33 lb (15 kg)

4. Remove the long pin on the right side of the bridge assembly. (See Figure 13.)
5. Unhook both springs from the left side of the bridge assembly, and remove the bridge assembly. (See Figure 14.)
6. Remove the front cover, exposing the front chain. (See Figure 15.)
7. Loosen the adjusting bolt, and rotate cam clockwise until the chain is free of slack. Retighten the adjusting bolt. (See Figure 16.)
8. Reassemble the cover, bridge assembly, and bend shoe.

Lubrication

- Chains do not require lubrication under normal work conditions. For corrosive environmental conditions, a 90 weight oil may be used.
- Lubricate rollers and pivot points with a light machine oil as necessary.

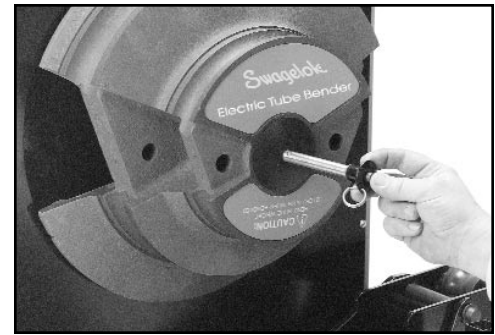


Figure 12



Figure 13



Figure 14

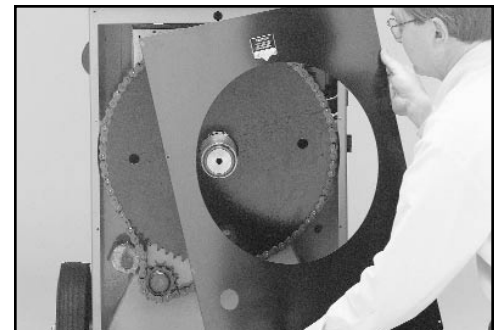


Figure 15

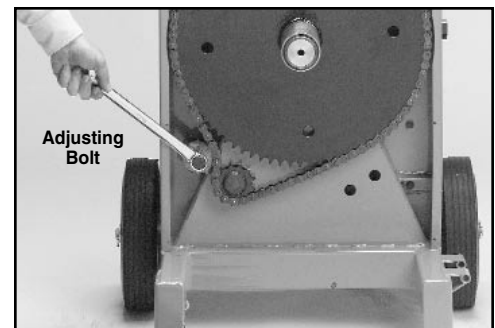


Figure 16

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THE SWAGELOK LIMITED LIFETIME WARRANTY

Swagelok hereby warrants to the purchaser of this Product that the non-electrical components of the Product shall be free from defects in material and workmanship for the life of the Product. All electrical components installed in or on the Product are warranted to be free from defects in material and workmanship for twelve months from the date of purchase.

The purchaser's remedies shall be limited to replacement and installation of any parts that fail through a defect in material or workmanship.

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